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MORNING SUNSHINE IN AUTUMN AND WINTER

ABSTRACT

Some figures are produced which relate to the amount of sunshine during each of the first 3 hours after sunrise from October to February. They suggest that on average the sun appears during the first hour on about 4 mornings a month for 0.3 hour and twice as often for twice as long during the second hour.

INTRODUCTION

Lettuce which are grown under glass or plastic during the autumn and winter are often subject to a physiological disorder known as veinal tip burn, the chief symptom of which is "glassiness". Essentially the disorder is brought about by the inability of the plants to transpire quickly enough the water taken up by the roots which are in relatively warm moist soil. The water accumulates in the leaf cells and the leaves take on a glassy and almost transparent appearance. If the excess water cannot be transpired within 3 hours after sunrise there is permanent damage to the plant tissue and the tips of the leaves turn brown. Control of the moisture regime during the late afternoon is probably the best defence but this is often difficult, particularly in plastic houses, and even with a well managed system there are occasions when surplus moisture accumulates overnight. For example during anticyclonic weather in autumn when there is a large diurnal range of temperature it may appear to be necessary to water the plants in the early afternoon, transpiration continues after the end of the working day when the plastic houses will have been shut and ventilation is minimal; the subsequent fall of temperature overnight results in condensation so that the air in contact with the plants is saturated or nearly so. The removal of this water is rather difficult especially in houses where there is no forced ventilation. Fans blowing warmed air through the houses will remove the water but though it saves the crop it is a rather expensive process because very much more air is heated than ever comes into contact with the crop. Many growers assert that the symptoms disappear very quickly on sunny mornings. But how frequent are sunny mornings in autumn and winter? Intuitively most meteorologists in the British Isles would reply 'not very frequent', but it is a bit difficult to back this assertion with published figures.

DATA USED

By chance the sunshine cards for the period October 1965 to December 1977 for Stratford-on-Avon became available. (The climatological station designated Stratford-on-Avon is located at Drayton Experimental Husbandry Farm of the Ministry of Agriculture, Fisheries and Food, about 3 miles west of Stratford.) After a table of sunrises for selected dates had been constructed neglecting refraction the cards were analysed according to the recommendations of the Mateorological Office Observers Handbook. In addition a note was made of those occasions when the sun made burns which did not qualify for measurement. In general only the first 3 hours were examined but several whole days were re-analysed when there appeared to be disparity between the burn and the amount entered on the card. The results are shown in the

table. Also shown are the solar elevations at the mid point of the period in mid month and the intensity of direct radiation corresponding to these elevations.

DISCUSSION

With regard to the first hour after sunrise it appears that intuition is not very far wrong; during the period examined there was very little sunshine during the first hour, but the amount during the second hour was roughly 5 times that in the first hour in October, November and December and $3\frac{1}{2}$ times that in the first hour in January and February. Even so the contribution to the total sunshine and the percentage of possible sunshine were small. The amounts were so small that rather than express them as very small fractions of an hour per day, it was decided to express them as fractions of hours on days when the sun appeared at some time or other during each relevant hour. The average number of days (in whole numbers) when this happened is also included in the table.

It is of interest to note that November, the month commonly associated with fogs, shows up as the best of the 5 for morning sunshine during the years in question. Reference to the 1941-1970 averages shows that during the period 1965-1977 only November had above average sunshine - about 22% above the long term average - whereas all the other months in varying degrees had below average sunshine, February being the worst, having had 11% below the long term average. Comparing the 2 autumn months, not only did November have a better percentage of long term average over this period than October, but the actual total during the first 3 hours was greater despite one day less in the month. A possible explanation for this is that during the years in question there were rather more Octobers in which the mean temperature was above the 1941-1970 average than those when the mean temperature was below average and there were some quite notable anticyclonic spells; on the other hand nearly all the Novembers had mean temperatures below the long term average. Anticyclonic weather in October is frequently associated with fog or stratus in the morning and sunshine and relative warmth in the afternoon. Low temperatures in November suggest a fairly high proportion of winds from North West to North bringing air of Polar origin over the country. The characteristic weather associated with this type of air at places well away from the North West coast is a sequence of clear skies during the night and early morning followed by the development of convection cloud by early afternoon and dispersal later. The distribution of sunshine during the Octobers and Novembers in question appears to fit with these suggested weather patterns.

It is not known whether the tendency towards Novembers rather colder than the 1941-1970 average will continue into the future, but any change to a higher frequency of milder Novembers would probably result in fewer occasions of northwesterly winds and consequently fewer fine mornings. So that any change is probably for the worse in this respect. A change to colder Octobers might result in more sunshine during the first hour but because the heating power of the sun is greater than in November, the development of convection cloud would be more rapid so that there might not be a comparable increase in the amount of sunshine in the following hours. A change to a higher frequency of colder winter months would probably result in more sunshine but average amounts in each of the morning hours would probably not increase as far as the upper limit of the range already experienced; and though there would probably be an improvement in sunshine, the gain in energy from this source would probably be offset by lower outside temperatures.

In all 5 months there has been a distinct tendency for more sunshine in the afternoon than in the morning, and it is difficult to envisage changes in the weather patterns which would reverse this distribution. Moreover during the first hour there is likely to be little change in the amount of sunshine and therefore direct radiation.

This analysis refers to one station only and it is perhaps unwise ~~the~~ to assume that the figures apply widely, but average daily sunshine totals vary by about half an

hour over a large part of Central England so that the variation during the first and second hours after sunrise is probably only a small fraction of this. There may be noticeable differences, however, nearer to the South coast.

CONCLUSIONS

It seems that unless there are substantial changes for the better in the amounts of sunshine received during the autumn and winter months - and this does not appear very likely - growers of protected crops should not adopt any strategies which rely on help from the sun in the first hour or 2 after sunrise. Methods and costings should assume no help from the sun during the first hour at least, and any sunshine that there may be can then be treated as a useful bonus.

It has been reported that leaving "thermal screens" in place in glasshouses for various periods after sunrise has very little effect on crop yields when the screens were left for 2 hours or less. This is hardly surprising considering the small amounts of direct radiation coming in. The comparisons which were made were essentially between plants which received small amounts of direct radiation with those which received even less, and the yield differences did not show.

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FIGURES RELATING TO DAILY SUNSHINE AND SUNSHINE IN FIRST THREE HOURS AFTER SUNRISE

DRAYTON EHF – STRATFORD ON AVON OCTOBER 1965 – DECEMBER 1977

	OCTOBER					NOVEMBER					DECEMBER					JANUARY					FEBRUARY				
	Whole Day	Sr + 1	Sr + 2	Sr + 3	First 3 hrs	Whole Day	Sr + 1	Sr + 2	Sr + 3	First 3 hrs	Whole Day	Sr + 1	Sr + 2	Sr + 3	First 3 hrs	Whole Day	Sr + 1	Sr + 2	Sr + 3	First 3 hrs	Whole Day	Sr + 1	Sr + 2	Sr + 3	First 3 hrs
Aggregate Hours (A)	1139.4	15.3	73.8	116.5	205.6	848.4	17.5	84.9	130.9	233.3	551.8	12.4	65.0	97.9	175.3	498.8	16.0	57.6	77.0	150.6	697.7	16.6	55.8	77.3	149.7
Average Monthly Hours	87.6	1.2	5.7	9.0	15.8	65.3	1.3	6.5	10.1	17.9	42.4	1.0	5.0	7.5	13.5	41.6	1.3	4.8	6.4	12.5	58.1	1.4	4.7	6.4	12.5
Monthly Range (Hours)	–	0 to 3.2	2.7 to 11.1	5.5 to 15.4	–	–	0.6 to 2.8	3.4 to 10.0	4.5 to 12.2	–	–	0.3 to 1.9	3.1 to 8.9	2.7 to 11.7	–	–	0.3 to 2.5	2.5 to 7.1	2.5 to 10.4	–	–	0 to 3.7	0 to 11.0	0.9 to 13.7	–
1941–1970 Average	93.4	–	–	–	–	53.3	–	–	–	–	45.0	–	–	–	–	46.2	–	–	–	–	65.1	–	–	–	–
Percentage contribution to total sun	–	1.3	6.5	10.2	18.0	–	2.1	10.0	15.4	27.5	–	2.2	11.8	17.8	31.8	–	3.2	11.5	15.4	30.2	–	2.4	8.0	11.1	21.5
Percentage of possible sun	–	3.8	18.3	28.9	17.0	–	4.5	21.8	33.6	19.9	–	3.0	16.1	24.3	14.5	–	4.3	15.5	20.4	13.5	–	4.9	16.5	22.7	14.7
Number of days when some mark was made (B)	–	51	127	189	201	–	59	148	180	196	–	50	119	157	168	–	58	108	133	151	–	53	107	121	142
Average of (B) above	–	4	10	15	15	–	5	11	14	15	–	4	9	12	13	–	5	9	11	13	–	4	9	10	12
AGGREGATE HOURS (A) / Number of Days (B)	–	0.3	0.6	0.6	1.0	–	0.3	0.6	0.7	1.2	–	0.25	0.5	0.6	1.0	–	0.3	0.5	0.6	1.0	–	0.3	0.5	0.6	1.0
Average Solar Elevation mid month	–	6.4° *	12.5°	19.5°	–	–	5.4° *	10°	15°	–	–	4.8° *	8.5°	12.5°	–	–	5.1° *	9.5°	13.8°	–	–	6.0° *	11.5°	18°	–
Radiation Intensity** corresponding to Solar elevation KW m⁻²	–	0.30	0.53	0.71	–	–	0.25	0.45	0.60	–	–	0.21	0.41	0.55	–	–	0.23	0.43	0.56	–	–	0.29	0.50	0.69	–

*Because sunshine traces rarely show much before half an hour after sunrise, the average solar elevation for the first hour refers to the period Sr + ½ to Sr + 1.

**Derived from: Neville R C Solar Energy Collector Orientation and Tracking Mode Solar Energy Vol 20 pp 7-11.